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PULL STRENGTH TESTING OF RESIN REBAR ROCK BOLTS IN THE HARBOUR SEAM DRIVAGE OF DONKIN MINE

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PULL STRENGTH TESTING OF RESIN REBAR ROCK BOLTS
IN THE HARBOUR SEAM DRIVAGE OF DONKIN MINE

by

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ABSTRACT

Pull strength tests were performed on six resin rebar rock bolts in the coal sample drivage of the Donkin mine. This report presents the results of the testing, indicating that all six bolts resisted a load of 19.6 tonnes without failure.

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ESSAIS DE RÉSISTANCE À LA TRACTION DE BOULONS D'ARMATURE À LA
RÉSINE DANS LA COUCHE D'ACCÈS HARBOUR DE LA HOUILLÈRE DONKIN

par

W.D. Gallant*

RÉSUMÉ

Des essais de résistance à la traction ont été effectués sur six boulons d'armature à la résine dans le traçage de charbon échantillon de la houillère Donkin. Les résultats de ces essais sont présentés dans le présent rapport, et ils indiquent que les six boulons ont résisté à la charge de 19,6 tonnes avec succès.

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INTRODUCTION

The Donkin mine is presently being developed. Access tunnels are being driven to a distance of 3.5 km to reach the Harbour Seam. Extraction of coal was originally designed to be by longwall methods, but since that time a room and pillar operation has been proposed.

Room and pillar mining would incorporate rock bolting for roof support. To aid in the design and evaluation of a rock bolt support plan, the Cape Breton Coal Research Laboratory (CBCRL) undertook a series of pull out resistance tests within the Harbour workings of the Donkin mine.

SITE DESCRIPTION

The test area is the coal sample drivage of the No. 2 Tunnel. The drivage was in seam with a 5.5 m width and a 2.5 m to 3.4 m height. Total length of the drivage was 127.5 m.

Roof coal was left in areas along the drift, but not at the location of the rock bolts. The immediate roof at the test section consisted of massive medium grained sandstone.

The six bolts were installed in two rows containing three bolts each. The rows are located at chainage 68 m and 69 m.

TEST PROCEDURE

Drilling of the six holes was accomplished with a stoper. The length of the holes was 1.8 m with a diameter of 38 mm. Installation procedures for the bolts varied.

Bolts No. 1, 2 and 3 were 1.5 m long and installed as dowels. Six resin cartridges (ground control fast) were placed in the hole. The bolt was pushed up the hole with the stoper while spinning slowly, when the bolt was completely up the hole, the bolt was spun at full rotation for 15 to 20 sec then allowed to set. Tightening of the nut and plate was done by a hand wrench after the resin had set.

Bolts No. 4, 5 and 6 were installed as pretensioned rock bolts. Two fast resin cartridges were placed up the hole followed by four slow resin cartridges (ground control). Installation of the bolt was by stopper, as previously, with the same procedure for spinning. To tighten the bolts an impact wrench was used. Tightening of the bolts was done after the fast resin had set but before the slow resin set, approximately 20 - 25 minutes. Testing was carried out on the bolts twenty-four hours after installation.

Load was applied to the bolts with an 'Enerpac' 30 ton hollow cylinder jack (Figure 1). To accommodate the jack, a length of 7/8" threaded bar was attached to the threaded bolt end with a coupling nut. The threaded bar provided sufficient length to extend through the hollow cylinder jack for attaching a bearing plate and nut.

Measurements of strain were made with 'Mitutoyo' dial gauges reading to 0.01 mm over a 75 mm travel. Magnetic 'V' blocks held the gauges to the jack while the travelling rod of the gauges rested on the bearing plate.

RESULTS

The results of the pull testing (Table 1) indicate that all six bolts withstood a load of 19.6 tonnes (Figure 2) with an extension not exceeding 23 mm. Bolts No. 4, 5 and 6 (Figures 3 and 4) offered a stiffer resistance to the applied load and this is due to the pretensioning of the bolt and its extra length.

CONCLUSIONS

The resin rebar bolts of 1.5 m and 1.6 m lengths can, when installed properly, withstand loads of at least 19.6 tonnes in a massive medium grained sandstone.

Table 1 - Load versus extension

<u>BOLT #1 - Length 1.5 m</u>												
Load in tonnes	1.6	3.3	4.9	6.5	8.2	9.8	11.4	13.1	14.7	16.4	18.0	19.6
Extension in mm	3.00	1.76	0.98	1.36	0.96	0.94	1.42	1.25	1.46	1.92	1.60	2.51
Cumulative Extension in mm	3.00	4.76	5.74	7.10	8.06	9.00	10.42	11.67	13.13	15.05	16.65	19.16
<u>BOLT #2 - Length 1.5 m</u>												
Load in tonnes	1.6	3.3	4.9	6.5	8.2	9.8	11.4	13.1	14.7	16.4	18.0	19.6
Extension in mm	4.68	1.07	0.84	0.73	0.76	0.92	0.89	1.41	1.10	1.32	1.66	2.02
Cumulative Extension in mm	4.68	5.75	6.59	7.32	8.08	9.00	9.89	11.30	12.40	13.72	15.38	17.40
<u>BOLT #3 - Length 1.5 m</u>												
Load in tonnes	1.6	3.3	4.9	6.5	8.2	9.8	11.4	13.1	14.7	16.4	18.0	19.6
Extension in mm	5.30	2.20	0.91	1.28	1.74	1.42	1.72	1.26	1.16	1.23	1.14	3.52
Cumulative Extension in mm	5.30	7.50	8.41	9.69	11.43	12.85	14.57	15.83	16.99	18.22	19.36	22.88
<u>BOLT #4 - Length 1.8 m</u>												
Load in tonnes	1.6	3.3	4.9	6.5	8.2	9.8	11.4	13.1	14.7	16.4	18.0	19.6
Extension in mm	3.06	0.91	0.98	0.68	0.60	0.60	0.58	0.66	0.66	0.72	1.83	2.08
Cumulative Extension in mm	3.06	3.97	4.95	5.63	6.23	6.83	7.41	8.07	8.73	9.45	11.28	13.36
<u>BOLT #5 - Length 1.8 m</u>												
Load in tonnes	1.6	3.3	4.9	6.5	8.2	9.8	11.4	13.1	14.7	16.4	18.0	19.6
Extension in mm	1.02	4.02	2.55	1.06	1.74	1.43	2.15	2.13	1.26	1.29	0.97	0.18
Cumulative Extension in mm	1.02	5.04	7.59	8.65	10.39	11.82	13.97	16.10	17.36	18.65	19.62	19.80
<u>BOLT #6 - Length 1.8 m</u>												
Load in tonnes	1.6	3.3	4.9	6.5	8.2	9.8	11.4	13.1	14.7	16.4	18.0	19.6
Extension in mm	5.99	1.12	0.68	0.62	0.67	0.59	0.75	0.96	0.98	0.74	1.04	2.30
Cumulative Extension in mm	5.99	7.11	7.79	8.41	9.08	9.67	10.42	11.38	12.36	13.10	14.14	16.44

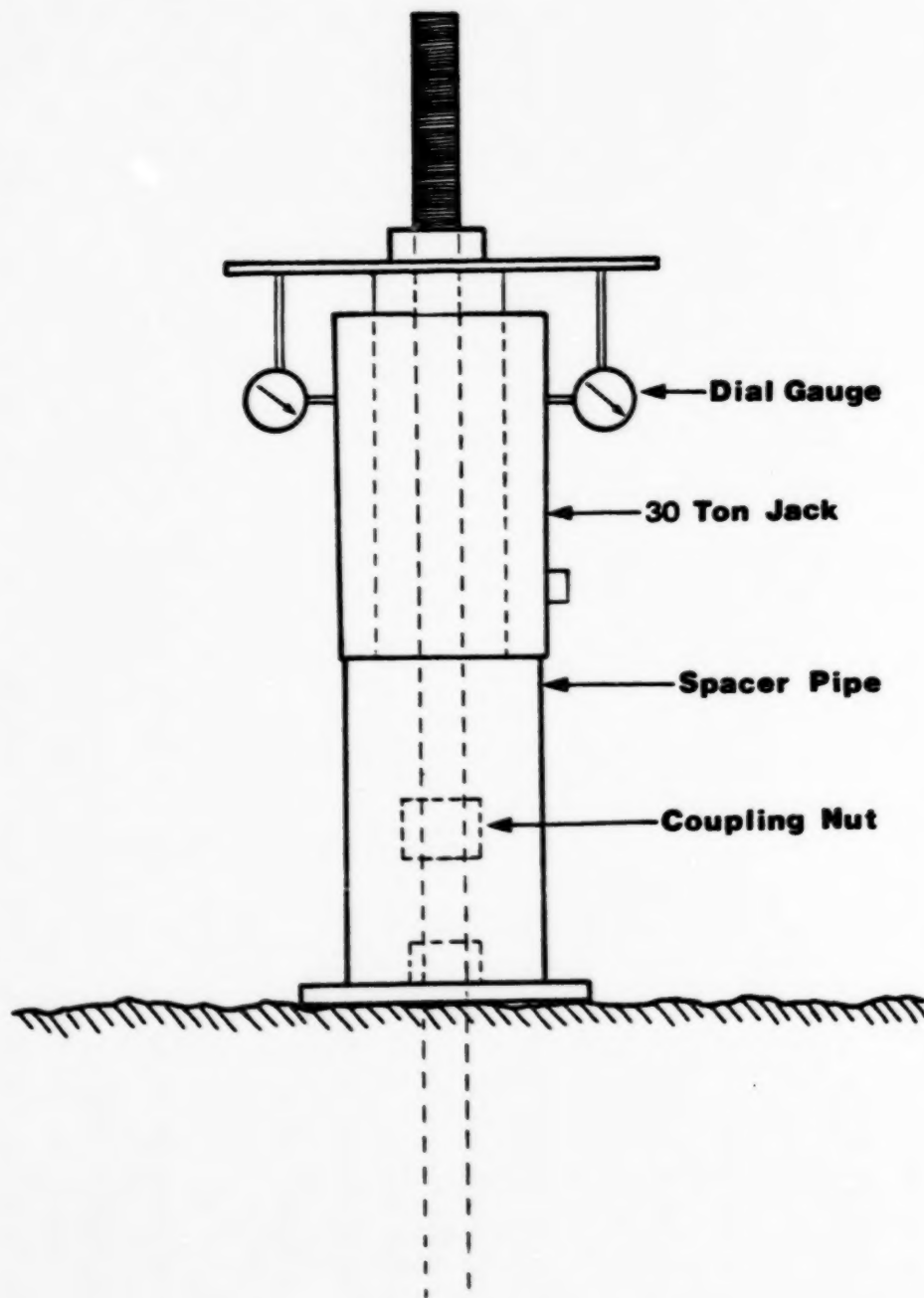


Figure 1 - Bolt pulling apparatus

ROCK BOLT PULL TEST - DONKIN MINE

#1 CROSSCUT

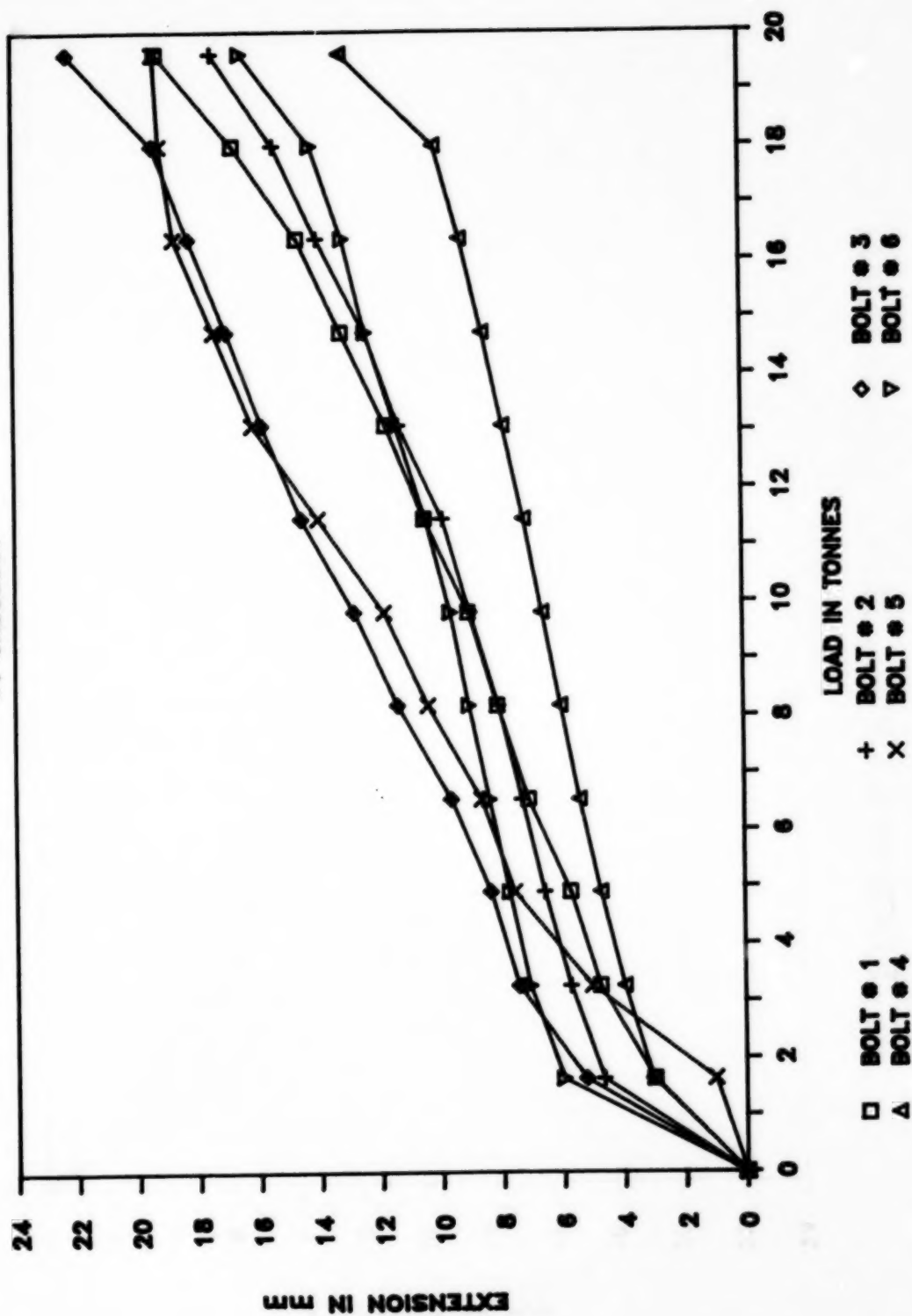


Figure 2 - Load versus extension, bolts 1-6

ROCK BOLT FULL TEST - DONKIN MINE

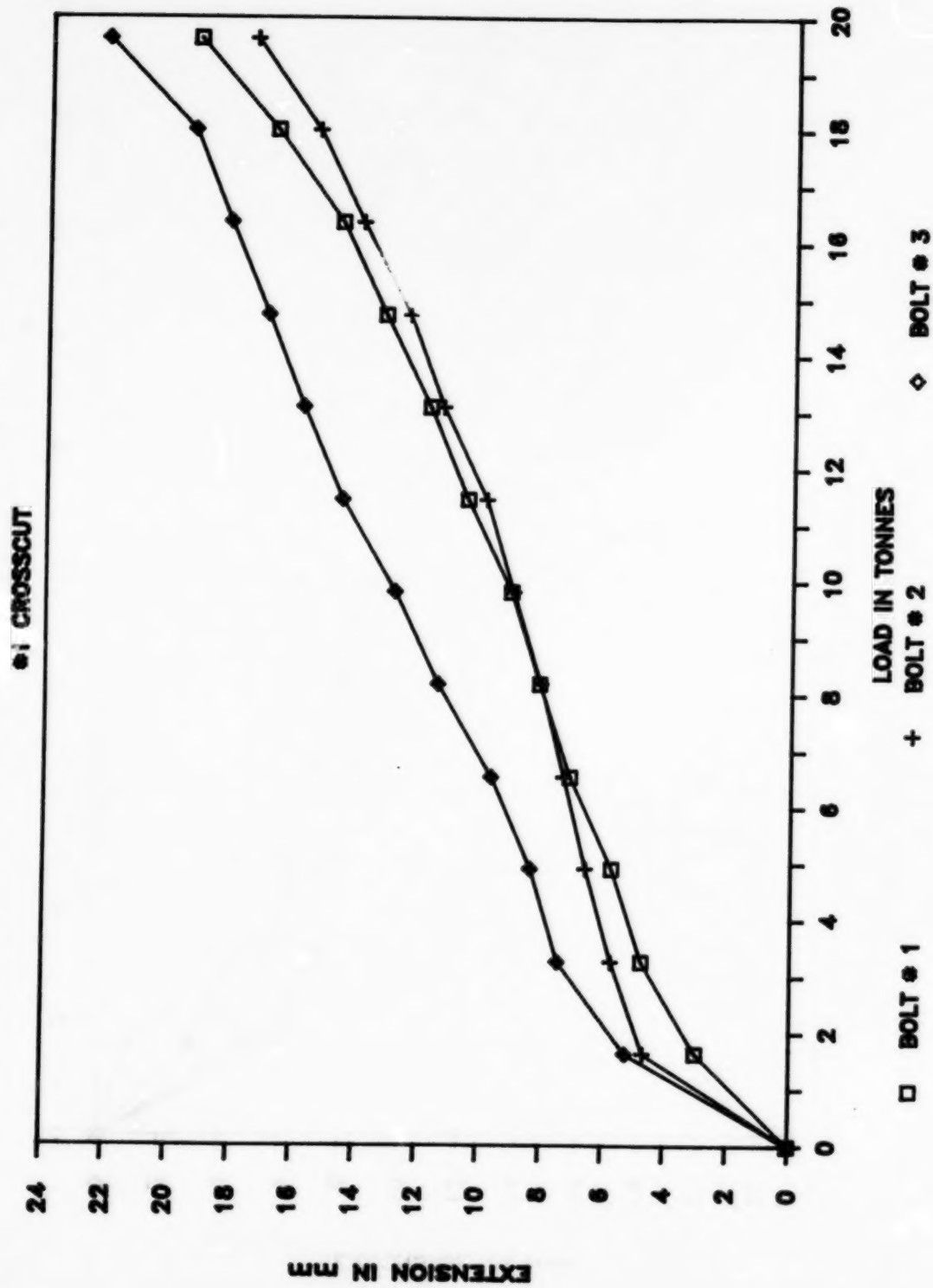


Figure 3 - Load versus extension, bolts 1-3

ROCK BOLT PULL TEST - DONKIN MINE

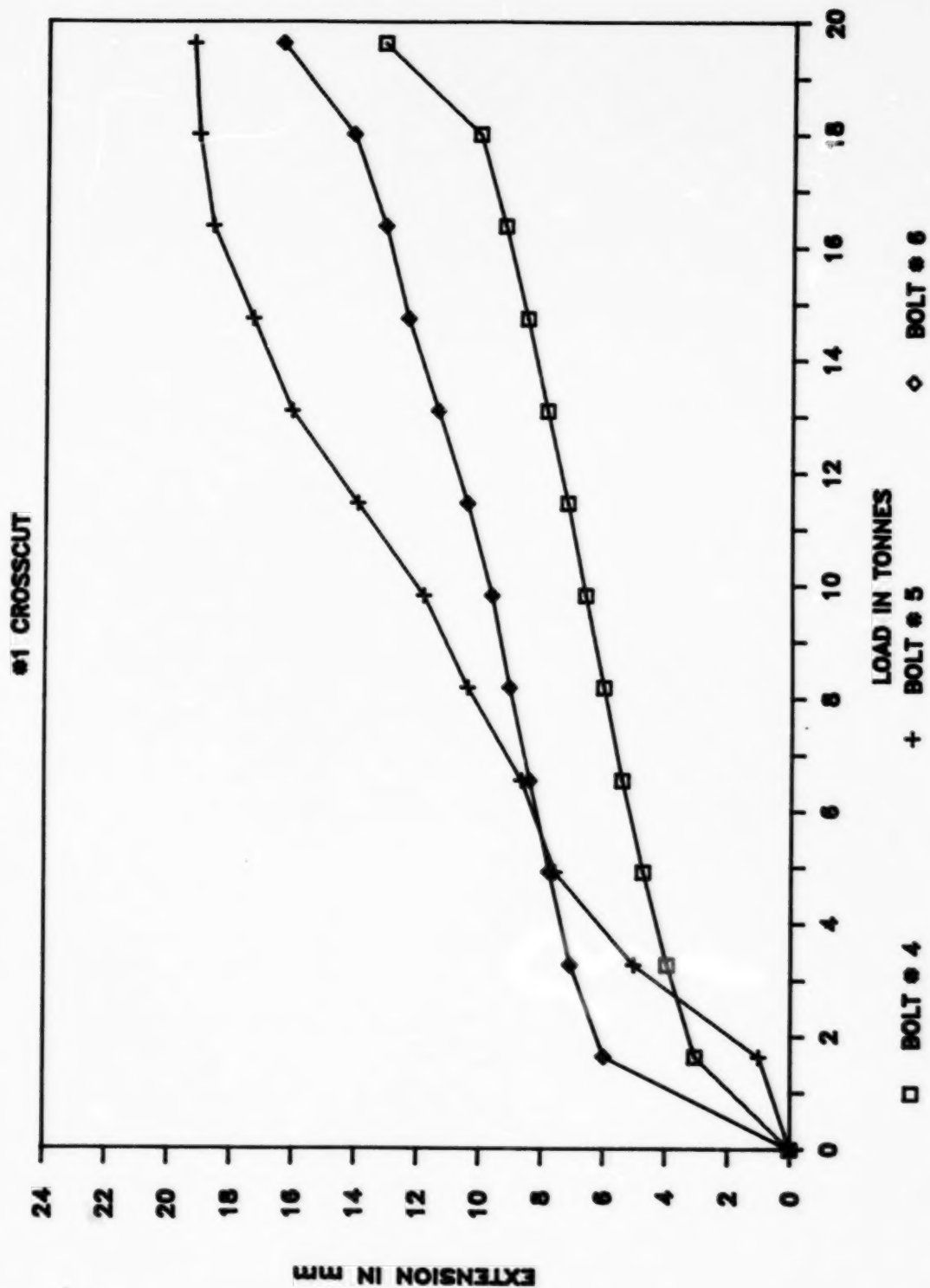


Figure 4 - Load versus extension, bolts 4-6